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Glycated albumin in monitoring diabetes mellitus

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Abstract

Diabetes mellitus (DM) is a disorder characterised by chronic hyperglycaemia. It is known that glycation of protein is increased in diabetic subjects than persons without diabetes. Glycated protein indices used for glucose monitoring include glycated hemoglobin and glycated albumin. The study was carried out to estimate serum glycated albumin (GA) and glycated haemoglobin (HbA1c) in diabetes mellitus and also to compare and correlate the blood glucose monitoring between glycated albumin (GA) and glycated haemoglobin (HbA1c) in patients with diabetes mellitus. It was a cross-sectional study conducted for a period of 24 months. Eighty two diagnosed cases of diabetes mellitus was included in the study. In the present study glycated albumin was positively correlated with fasting blood glucose (r=0.657; p=0.00), post prandial plasma glucose(r=0.486; p=0.00) and glycated haemoglobin (r=0.665, p=0.000). This study shows that glycated albumin can be utilised as an intermediate glycemic marker for monitoring diabetes.

Keywords: Diabetes Mellitus, glycated albumin, glycated hemoglobin

Introduction

Diabetes mellitus (DM) is a group of metabolic disorder characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. International Diabetes Federation (IDF) estimates that approximately 537 million adults (20-79 years) are living with diabetes which is projected to rise to 643 million by 2030 and 783 million by 2045. In diabetic patients glucose monitoring is essential for glycemic control. Diagnosis of diabetes mellitus is currently done using fasting plasma glucose (FPG), 2h-plasma glucose (2h-PG)

during a 75 g oral glucose tolerance test (OGTT) and glycated haemoglobin (HbA1c) level and HbA1c is the reference test used for long term blood glucose monitoring over the last 2-3 months. Glycated protein indices used for glucose monitoring include glycated hemoglobin and glycated albumin. In the past few years, glycated albumin (GA) has gained more attention being a new parameter for glycaemic control monitoring. Glycation of protein is increased in diabetic subjects than persons without diabetes. Glycation is a non-enzymatic spontaneous reaction where a reducing sugar is added to a free amino group. GA reflects short to intermediate term mean glycemic levels due to half lifetime of albumin which is approximately 3 weeks, and also GA levels are not affected by changes in erythrocyte lifespan. So, its measurement is not influenced by conditions such as haemolytic anemias or bleeding episodes that might falsely reduce HbA1c levels, or iron deficiency anemias, thalassemia or other hemoglobinopathies which may falsely elevate HbA1c level. Moreover, albumin is approximately 10 times more sensitive to glycation as compared to haemoglobin. The aim of the study is to estimate the level of glycated albumin (GA) in patients with diabetes mellitus and to correlate it with fasting blood glucose, 2-hr post prandial blood glucose and HbA1c.

Materials and Method

A cross-sectional study was conducted on already diagnosed 82 cases of diabetes mellitus from October 2019 to September 2021. Diagnosis was done according to American Diabetes Association criteria. Written informed consent was taken from all the participants. Venous blood samples were collected after overnight fasting and after 2 hours post meal for fasting glucose and 2-hr post prandial blood glucose in fluoride vial and for HbA1c in EDTA vial. For GA and serum albumin estimation, blood samples were collected in plain vial and serum separated by centrifugation at 3000 rpm for 10 mins, and albumin estimation done on the day itself and remaining serum was frozen for subsequent analysis of GA. This study was approved by Research Ethics Board, Regional Institute of Medical Science, Imphal. Pregnancy, chronic liver disease, chronic kidney disease, hemoglobinopathies, hypo or hyperthyroidism and patients under glucocorticoid treatment were excluded from the study. Estimation of glycated albumin (GA) was done with “Human Glycated Albumin (GA) ELISA Kit Cataloged No. K12- 0030, KINESISDx USA” by ELISA method using Merilyzer EIAQuant, Glycated haemoglobin (HbA1c) by automatic hemoanalyzer ADAMs A1c by high performance liquid chromatography method and serum albumin by Bromocresol green (BCG) by RANDOX Rx IMOLA autoanalyser. GA% was calculated by dividing GA concentration by albumin concentration multiplied by 100. Data were analysed using SPSS version 21. Descriptive statistics like mean and percentage were used. Chi-square test was used to compare means and Pearson’s correlation was used to find out the correlation between the variables. P value <0.05 was taken as significant.

Results

A total of 82 cases of Diabetes Mellitus were included, of which 45 (54.9%) were male and 37 (45.1%) were female. The mean ± SD of age, fasting blood glucose and post-prandial blood glucose were 52.65 ± 11.4 years, 146.88 ± 60.47 mg/dl and 211.32 ± 76.88 mg/dl respectively.

Table 1: Variables with Mean ± SD

Variables	Mean ± SD
Age (years)	52.65 ± 11.4
BMI (kg/m^2)	24.47 ± 2.95
Serum albumin (g/dl)	4.12 ± 0.54
Fasting blood glucose (mg/dl)	146.88 ± 60.47
Post-prandial glucose (mg/dl)	211.32 ± 76.88
GA (%)	17.85 ± 3.16
HbA1c (%)	7.44 ± 1.58

Table 1, shows the mean and standard deviation of various variables included in the study. The mean ± SD of age and BMI were 52.65 ± 11.4 years and 24.47 ± 2.95 kg/m^2 respectively. The fasting blood glucose and post-prandial blood glucose were 146.88 ± 60.47 mg/dl and 211.32 ± 76.88 mg/dl respectively, which is more than the normal range. The mean ± SD of GA was 17.85 ± 3.16 % and for HbA1c was 7.44 ± 1.58 %.

Table 2: Distribution of glycated albumin in relation to sex

Sex	Glycated albumin (%)			P value
	<15	15-17	>17	
Male	20	9	16	0.088
Female	8	12	17	
Total	28	21	33	

As observed from Table 2, 33 respondents have more than 17% glycated albumin, 21 respondents have 15-17 % and 28 respondents have less than 15 % glycated albumin and no statistical significance (p=0.088) was observed between male and female.

Table 3: Correlation between serum albumin and glycated albumin

Serum Albumin	Glycated albumin			Total	P value	Pearson Correlation
	<15	15-17	>17			
2.6-3.5	3	3	1	7	0.310	0.123
>3.5	25	18	32	75		
Total	28	21	33	82		

As evident from Table 3, serum albumin is positively correlated with glycated albumin but statistically insignificant (p >0.05)

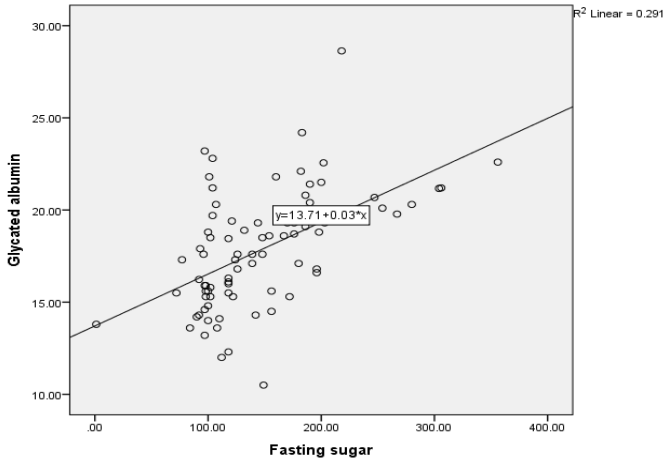

Figure 1: Correlation of glycated albumin with fasting blood sugar

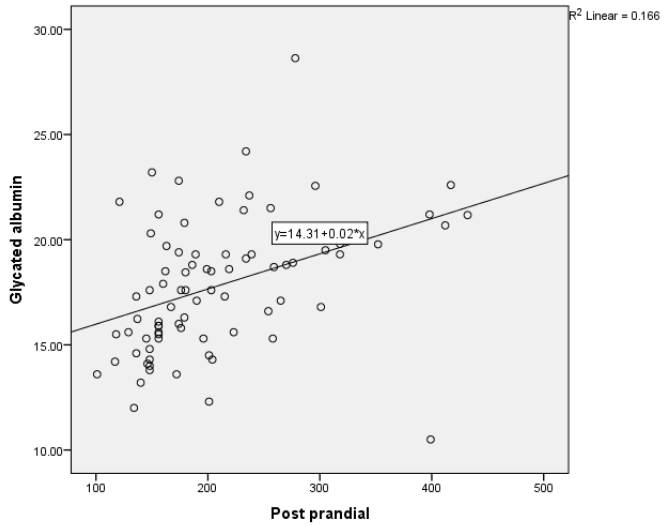

Figure 2: Correlation of glycated albumin with post-prandial blood sugar

Figure 1 & 2 shows the correlation of glycated albumin (GA) to fasting and post-prandial blood glucose. We found that GA is significantly correlated with fasting (r=0.657; p=0.00) and post-prandial blood glucose (r=0.486; p=0.00).

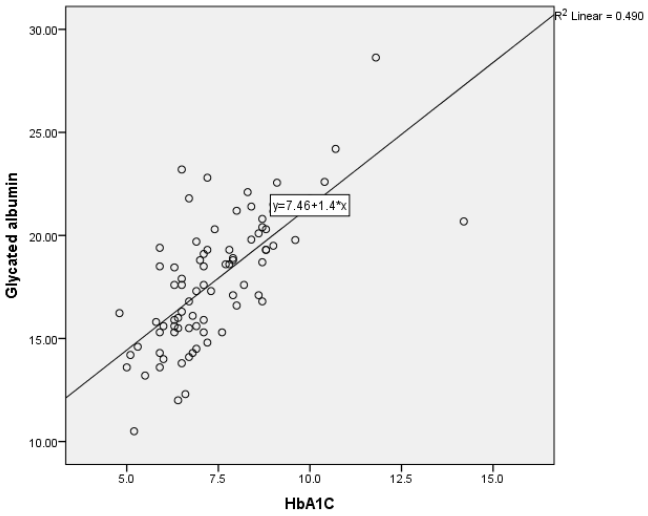

Figure 3: Correlation of glycated albumin (%) with glycated hemoglobin (%)

Figure 3 shows the correlation of GA with HbA1c. We found that GA is positively correlated with HbA1c (r=0.665) and also statistically significant (p=0.000).

Discussion

The study has been conducted to estimate serum Glycated albumin levels and to correlate it with fasting blood glucose, post-prandial blood glucose and HbA1c levels in Diabetes mellitus. In this study (Table 1), the mean ± SD of fasting and post-prandial blood glucose was 146.88 ± 60.47 mg/dl and 211.32 ± 76.88 mg/dl respectively which is above the cut off value for the diagnosis of diabetes according to WHO criteria. The mean ± SD of BMI was 24.47 ± 2.95 kg/m^2, which belongs to overweight category according to Asia-pacific guidelines for classification of BMI. Gupta S et al, showed that both the average blood glucose level and average diabetes prevalence are higher among overweight or obese individuals as compared to non-overweight individuals. Average diabetes prevalence is 3 times among the overweight or obese individuals as compared to the non-overweight individuals. Mean blood glucose are 10 mg/dl higher among overweight or obese individuals. The mean ± SD of glycated albumin was 17.85 ± 3.16 % which is above the normal reference range in American population (i,e normal range 11.9-15.8%) as observed from the study conducted by Kohzuma T et al.

In Table 2, 33 respondents have more than 17% glycated albumin levels, out of which 16 were males and 17 were females, 21 respondents have glycated albumin levels within 15-17 %, out of which 9 were males and 12 were females and 28 respondents have less than 15 % glycated albumin levels (20 were males and 8 were females). Chi-square test was applied and it was found to be statistically insignificant (p>0.05). This demonstrates that glycated albumin has no significant differences between males and females. Our findings are consistent with the findings of Furusyo N et al who observed no significant sex differences in glycated albumin levels.

Serum albumin was positively correlated with glycated albumin (table 3) but statistically insignificant (r=0.123; p=0.310). The findings were supported by a study conducted by Peacock TP et al, who observed that GA % is not associated with serum albumin. However, the findings of Wu WC et al, were contradictory who observed that serum glycated albumin was negatively associated with serum albumin. For every 1 g/dl increase in serum albumin, serum glycated albumin was observed to decrease by 0.32 %. Peacock TP et al explained the difference in the result could be because of the use of different methods for albumin estimation. Bromocresol purple method gives an approximately 20 % lower value as compared to Bromocresol green method. But theoretically, glycated albumin levels should not be affected by the serum albumin levels, since its values are corrected for the total albumin.

In the study (Figure 1) glycated albumin was positively correlated with fasting blood glucose (r=0.657; p=0.00). The findings was consistent with the findings of Ciobanu DM et al, that showed significant correlation between glycated albumin and fasting blood glucose (r=0.32; p<0.001).This findings is again supported by the findings of Furusyo N et al that demonstrated a significant correlation (r=0.706, p<0.001). Our study (Figure 2) also shows that glycated albumin is positively correlated with post-prandial blood glucose (r=0.486; p=0.00), which is similar with the findings of Seddik MY et al.

In this study, glycated albumin is positively correlated with HbA1c and was also found to be statistically significant (r=0.665, p=0.000) which was similar to the findings of Jung CH et al (r=0.915; p<0.001).[19] As plasma albumin is glycated in the blood at four sites of lysine residues and also glycation process is 10 times faster as compared to that of haemoglobin. Therefore, GA may be more advantageous for reflecting rapid changes of the glucose concentration as compared with glycated haemoglobin. A study conducted by Desouza CV et al, comparing glycated albumin (GA) and glycated haemoglobin (HbA1c) in type 2 diabetes patients for over 16 weeks found that GA decreased more rapidly than HbA1c as glycemic control improved. These results support the utility of GA in detecting short term changes in glycemic control. Also, it might be advantageous in certain conditions such as advanced CKD, anemia, thalassemia and in pregnancy were HbA1c might give false results. The limitation of the present study is that it was a one-time study with small sample size.

Conclusion

Albumin is the most abundant plasma protein with half-life of approximately 3 weeks. Therefore, glycated albumin (GA) can be used for monitoring blood glucose fluctuation for the last 3 weeks. It is noted from this study that glycated albumin is significantly and positively correlated with fasting plasma glucose, post prandial blood glucose and glycated haemoglobin (HbA1c), which thus provides evidence for the probability of use of glycated albumin as an adjunct or an alternative laboratory test for the diagnosis and also for monitoring glycemic variability for patients with diabetes mellitus.

References

1. American Diabetes Association. Diabetes care. 2009 Jan;32(Suppl 1):S62-S67.
2. Sayed ZHE, Ismail SM, Hagrasy HAE. Glycated albumin as a predictor of glycemic state in type 2 diabetes mellitus and chronic kidney disease. Int J Diabetes Res. 2018;7(3):50-6.
3. Li GY, Li HY, Li Q. Use of glycated albumin for the identification of diabetes in subjects from northeast China. World J Diabetes. 2021;12(2):149-57.
4. Ciobanu DM, Bogdan F, Patrut CI, Roman G. Glycated albumin is correlated with glycated haemoglobin in type 2 diabetes. Med Pharm Rep. 2019;92(2):134-8.
5. Kim KJ, Lee BW. The roles of glycated albumin as intermediate glycation index and pathogenic protein. Diabetes Metab J 2012;36(2):98-107.
6. Dinu IR, Mota E. Glycated albumin-More than the missing link in the evaluation of diabetes control. Rom J Diabetes Nutr Metab Dis. 2014;21(2):137-50.

7. Anguizola J, Matsuda R, Barnaby OS, Hoy KS, Wa C, Debolt E, et al. Glycation of human serum albumin. Clin Chim Acta. 2013 October;21:64-76.
8. Ciobanu DM, Bogdan F, Patrut CI, Roman G. Glycated albumin is correlated with glycated haemoglobin in type 2 diabetes. Med Pharm Rep. 2019;92(2):134-8.
9. Powers AC. Diabetes mellitus: Diagnosis, classification, and pathophysiology. In: Kasper DL, Hauser SL, Jameson JL, Fauci AS, Longo DL, Loscalzo J, editors. Harrison's principles of internal medicine 19th Edn. USA: MCGraw Hill Education; 2015.
10. Lim JU, Lee JH, Kim JS, Hwang Y, Kim TH, Lim SY, et al. Comparison of world health organization and asia-pacific body mass index classifications in copd patients. Int J Chron Obstruct Pulmon Dis. 2017;12:2465-75.
11. Gupta S, Bansai S. Does a rise in BMI cause an increased risk of diabetes?: Evidence from India. PLOS ONE. 2020;15(4):e0229716.
12. Kohzuma T, Yamamoto T, Uematsu Y, Shihabi ZK, Freedman BI. Basic performance of an enzymatic method for glycated albumin and reference range determination. J Diabetes Sci Technol. 2011 November;5(6):1455-62.
13. Furosyo N, Koga T, Ai M, Otokozawa S, Kohzuma T, Ikezaki H, et al. Utility of glycated albumin for the diagnosis of diabetes mellitus in a Japanese population study: results from the Kyushu and Okinawa population study (KOPS). Diabetologia. 2011;54(12):3028-36.
14. Peacock TP, Shihabi ZK, Bleyer AJ, Dolbare EL, Byers JR, Knovich MA, et al. Comparison of glycated albumin and haemoglobin A1c levels in diabetic subjects on hemodialysis. Kidney Int. 2007;73(9):1062-8.
15. Wu WC, Ma WY, Wel JN, Yu TY, Lin MS, Shih R, et al. Serum glycated albumin to guide the diagnosis of diabetes mellitus. PLOS ONE. 2016;11(1):e0146780.
16. Freitas PAC, Ehlert LR, Camargo JL. Glycated albumin: a potential biomarker in diabetes. Arch Endocrinal Metab. 2017;61(3):296-304.
17. Seddik MY, Mohammed SE, Mohammed AB, Renia YE. Converse contributions of fasting and postprandial glucose to HbA1c and glycated albumin. IJAR. 2016;4(3):887-91.
18. Jung CH, Hwang YC, Kim KJ, Cha BS, Park CY, Jeon WS. Development of an HbA1c-based conversion equation for estimating glycated albumin in a korean population with a wide range of glucose intolerance. PLOS ONE. 2014;9(4):e95729.
19. Suwa T, Ohta A, Matsui T, Koganei R, Kato H, Kawata T, et al. Relationship between clinical markers of glycemia and glucose excursion evaluated by continuous glucose monitoring. Endocr J. 2010;57(2):135-40.
20. Desouza CV, Rosenstock J, Zhou R, Holcomb RG, Fonseca VA. Glycated albumin at 4 weeks correlates with A1c levels at 12 weeks and reflects short-term glucose fluctuations. Endocr Pract. 2015 November;21(11):1195-203.